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(71)Applicant : KAWASAKI STEEL CORP

(72)Inventor : SUZUKI YOSHITSUGU
TOBIYAMA YOICHI
KATO CHIAKI

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(54) PRODUCTION OF HIGH STRENGTH HOT DIP GALVANIZED STEEL SHEET EXCELLENT IN BALANCE OF STRENGTH AND DUCTILITY

(57)Abstract:

PROBLEM TO BE SOLVED: To impart an excellent balance of strength and ductility to a steel sheet by subjecting a hot rolled steel sheet having a specified componential compsn. to heating and cooling at specified temps. for specified times, thereafter pickling the surface by a specified pickling loss, holding it under heating at a specified temp. for a specified time, executing cooling to a specified temp. at a specified cooling rate and applying plating thereon.

SOLUTION: A hot rolled steel sheet contg., by weight, 0.05 to 0.25% C≤2.0% Si, 1.0 to 2.5% Mn and 0.005 to 0.10% Al is heated at 800 to 1000°C for 10 to 120 sec

and is cooled to 300°C at a cooling rate of ≥40°C/sec, and, after that, the surface of the steel sheet is pickled under the condition of 0.05 to 5 g/m2 pickling loss expressed in terms of Fe. Next, in a continuous hot dip galvanizing line, the steel sheet is again head at a temp. of 725 to 840°C for 5 to 200 sec, is thereafter cooled to ≤600°C at a cooling rate of 2 to 50°C/sec and is applied with plating. At this time, the concn. of hydrogen in the atmosphere in the heating stage before the pickling is controlled to 1 to 100 vol%, and the ratio of the respective partial pressure between H2O and H2 in the heating atmosphere is controlled to the value expressed by the formula to the content (weight %) of Si in the steel.

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CLAIMS

[Claim(s)]
[Claim 1] The hot rolled sheet steel containing less than [Si:2.0wt%], Mn:1.0 - 2.5wt%, and aluminum:0.005 - 0.10wt% C:0.05 - 0.25wt% After heating for 10 - 120 seconds at the temperature of 800-1000 degrees C and cooling to 300 degrees C or less with the cooling rate of 40 degrees C/second or more, Pickling weight loss is 0.05 - 5 g/m2 by Fe conversion. Acid washing of the steel plate front face is carried out on conditions. Subsequently, the manufacture approach of a high intensity melting galvanized steel sheet of having excelled in the on-the-strength ductility balance characterized by cooling and plating to 600 degrees C or less with the cooling rate of 2-50 degrees C/second after holding said steel plate for 5 - 200 seconds in temperature of 725-840 degrees C again with a continuation melting galvanization line.
[Claim 2] The hydrogen concentration of an ambient atmosphere [in / on said manufacture approach and / the heating process before acid washing] is H2 O in a 1 - 100vol% and heating ambient atmosphere, and H2. The ratio of each partial pressure receives the amount of Si in steel (wt%). 0.3 >=log(H2 O/H2) >=2Si(wt%)-4 (1)
The manufacture approach of a high intensity melting galvanized steel sheet excellent in the on-the-strength ductility balance according to claim 1 which comes out and is characterized by a certain thing.
[Claim 3] In said manufacture approach, the hydrogen concentration of the annealing ambient atmosphere at the time of giving melting galvanization is 1 - 100wt%, and it is H2 O in an annealing ambient atmosphere, and H2. The ratio of each partial pressure receives (degree C) whenever [stoving temperature]. H2 O/H2 <=exp (f(T) / RT) (2)
However, f(T) =aT2+bT+cTlog T+d (3)
The manufacture approach of a high intensity melting galvanized steel sheet excellent in the on-the-strength ductility balance according to claim 1 or 2 characterized by filling the relation of (degree-C) +273a:-0.0054b:11.16c:0.625d:-13092 whenever [T(degree of ******: K) = stoving temperature].
[Claim 4] The manufacture approach of a high intensity melting galvanized steel sheet excellent in the on-the-strength ductility balance according to claim 1 to 3 characterized by performing heating alloying processing further after melting galvanization in said manufacture approach.
[Claim 5] The manufacture approach of a high intensity melting galvanized steel sheet of having excelled in the on-the-strength ductility balance according to claim 1 to 4 characterized by annealing in said manufacture approach after carrying out cold-rolling of the hot rolled sheet steel.
[Claim 6] The manufacture approach of a high intensity melting galvanized steel sheet excellent in the on-the-strength ductility balance according to claim 1 to 5 to which the rolling-up temperature of hot rolled sheet steel is 600 degrees C or more, and the cooling rate after rolling up considers as the description that it is [3 degree-C] the following by /in said manufacture approach.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the manufacture approach of a high intensity melting galvanized steel sheet excellent in the on-the-strength ductility balance which can fully be equal also to complicated press-forming processing.
[0002]
[Description of the Prior Art] Generally, since ductility, such as all elongation and bending, falls as reinforcement rises, as for hot-rolling or cold rolled sheet steel, complicated press working of sheet metal becomes difficult. Moreover, in order to make the reinforcement of a steel plate increase generally, adding elements, such as Mn and Si, promoting solid solution strengthening and good complex tissue-ization, and making on-the-strength-elongation balance advantageous is known. however -- since Mn, Si, etc. are easy-oxidizable elements, if it adds so much -- the time of annealing -- front faces, such as Si and Mn, -- concentration -- in order for an object to deposit on a steel plate front face and to degrade wettability with melting zinc, the defect in which it does not plate occurs in the case of the continuous system melting galvanization following annealing.
[0003] The method of manufacturing the steel plate excellent in on-the-strength ductility balance is indicated by making the organization which quenches in them and becomes it from a ferrite and martensite equality as a steel plate with such a property after making the organization which quenches at the time of hot-rolling rolling up, quenches at it, and contains a martensitic phase form in JP,2-175817,A, the patent No. 1313144 official report, etc. and heating in it to a two-phase region at the time of afterbaking dull form. However, since the first histogenesis is performed at the time of hot-rolling and a make lump of the last organization is performed by this approach at the time of annealing, it is impossible to add annealing and the continuous system melting galvanization process of performing plating to coincidence. Therefore, by this approach, the high intensity melting galvanized steel sheet excellent in on-the-strength ductility balance cannot be manufactured.
[0004] Moreover, after carrying out quenching quenching at the time of hot-rolling rolling up and annealing in a melting galvanization line to JP,5-179356,A, JP,5-51647,A, etc. in a two-phase region as the manufacture approach of a high intensity melting galvanized steel sheet excellent in workability etc., the approach of plating is indicated, but if Si is added in fact, it will be easy to generate un-plating. That is, since the defect in which it does not plate will occur for surface concentration of Si and Mn if a steel plate with many Si and Mn contents is plated with this approach, it is impossible to manufacture the melting galvanized steel sheet containing Si and Mn as a matter of fact.
[0005]
[Problem(s) to be Solved by the Invention] Using a continuous system melting galvanization line, even if this invention contains Si and Mn so much, it aims at offering the approach of manufacturing the high intensity melting galvanized steel sheet excellent in on-the-strength ductility balance without the defect in which it does not plate.
[0006]

[Means for Solving the Problem] This invention Therefore, C:0.05 - 0.25wt%, less than [Si:2.0wt%], The hot rolled sheet steel containing Mn:1.0 - 2.5wt% and aluminum:0.005 - 0.10wt% After heating for 10 - 120 seconds at the temperature of 800-1000 degrees C and cooling to 300 degrees C or less with the cooling rate of 40 degrees C/second or more, Pickling weight loss is 0.05 - 5 g/m2 by Fe conversion. Acid washing of the steel plate front face is carried out on conditions. Subsequently, after holding said steel plate for 5 - 200 seconds in temperature of 725-840 degrees C again with a continuation melting galvanization line It is the manufacture approach of a high intensity melting galvanized steel sheet excellent in the on-the-strength ductility balance characterized by cooling and plating to 600 degrees C or less with the cooling rate of 2-50 degrees C/second.

[0007] Moreover, for desirable this invention, the hydrogen concentration of an ambient atmosphere [in / on said manufacture approach and / the heating process before acid washing] is H2 O in a 1 - 100vol% and heating ambient atmosphere, and H2. The ratio of each partial pressure receives the amount of Si in steel (wt%). 0.3 >=log(H2 O/H2) >=2Si(wt%)-4 (1)

It is the manufacture approach of a high intensity melting galvanized steel sheet excellent in the on-the-strength ductility balance which comes out and is characterized by a certain thing.

[0008] Moreover, in said manufacture approach, the hydrogen concentration of the annealing ambient atmosphere at the time of giving melting galvanization is 1 - 100wt%, and desirable this invention is H2 O in an annealing ambient atmosphere, and H2. The ratio of each partial pressure receives (degree C) whenever [stoving temperature]. H2 O/H2 <=exp (f(T) / RT) (2)

However, f(T) =aT2+bT+cTlog T+d (3)

It is the manufacture approach of a high intensity melting galvanized steel sheet excellent in the on-the-strength ductility balance characterized by filling the relation of (degree-C)+273a:-0.0054b:11.16c:0.625d:-13092 whenever [T(degree of ******: K) = stoving temperature].

[0009] Moreover, desirable this invention is the manufacture approach of a high intensity melting galvanized steel sheet excellent in the on-the-strength ductility balance characterized by performing heating alloying processing further after melting galvanization in said manufacture approach.

[0010] Moreover, in said manufacture approach, desirable this invention is the manufacture approach of a high intensity melting galvanized steel sheet excellent in the on-the-strength ductility balance characterized by annealing, after carrying out cold-rolling of the hot rolled sheet steel.

[0011] Moreover, desirable this invention is the manufacture approach of a high intensity melting galvanized steel sheet excellent in the on-the-strength ductility balance characterized by for the rolling-up temperature of hot rolled sheet steel being 600 degrees C or more, and the cooling rate after rolling up being 3 degrees C or less in said manufacture approach.

[0012]

[Embodiment of the Invention] Aiming at achievement of said purpose, on the basis of the following conditions, this invention person tried much experiments and reached this invention. C: S:0.003wt%, aluminum:0.04wt%, the sheet bar with a thickness [containing N:0.002wt% and O:0.002wt%] of 30mm was heated at 1200 degrees C, and it considered as hot rolled sheet steel with a thickness of 2.0mm with five pass, and rolled round at 500-750 degrees C P:0.01wt% Mn:1.5wt% Si:0.2 - 2.0wt% 0.15wt%. Subsequently, acid washing removes a scale, and it sets to the annealing furnace for an experiment, and is H2. By changing concentration by 1-100vol %, and changing a dew-point among -60-+20 degrees C, respectively H2 O/H2 10-80 degrees C/second in rate after heating the hot rolled sheet steel to which the division ratio was changed between 0.00002-2 for 80 seconds at 900 degrees C -- up to 300 degrees C -- quenching -- annealing -- a 60-degree C 5wt% hydrochloric acid -- acid washing during 10 seconds -- carrying out -- a front face -- concentration -- the object was removed.

[0013] Then, it sets to a vertical-type annealing gilding machine, and is H2. By changing concentration by 1-100vol %, and changing a dew-point among -60-+20 degrees C, respectively H2 O/H2 It plated for 1 second in the melting zinc bath of 465 degrees C of bath temperature aluminum concentration 0.15wt% in a bath immediately after quenching and annealing it to 470 degrees C at 10-80 degrees C/second in rate, after heating the hot rolled sheet steel to which the division ratio was changed between 0.002-0.6 for 20 seconds at 750 degrees C.

[0014] Consequently, respectively, as shown in drawing 1 (it anneals for 20 seconds for 80 seconds Si:1.0wt% at annealing:CGL:5%H2, -35 degrees C of dew-points, and 750 degrees C by CAL:3%H2, +15 degrees C of dew-points, and 750 degrees C), when CAL and the cooling temperature at the time of CGL annealing are within the limits of 40 degrees C /or more and 2 degrees C/second or more, the tensile strength of the obtained melting galvanized steel sheet and elongation have them. [good a second]

[0015] Moreover, H2 O/H2 of an ambient atmosphere [in / as shown in drawing 2 / the heating process before acid washing] A division ratio receives the amount of Si in steel. 0.3 >=log(H2 O/H2) >=2Si (wt%)-4 (1)

H2 O/H2 of the annealing ambient atmosphere at the time of plating as it is ******** and is further shown in drawing 3 A division ratio receives whenever [stoving temperature]. H2 O/H2 <=exp (f(T) / RT) (2)

However, f(T) =aT2+bT+cTlog T+d (3)

It became clear that what is within the limits of (degree-C)+273a:-0.0054b:11.16c:0.625d:-13092 whenever [T(degree of ******: K) = stoving temperature] has good plating nature.

[0016] In addition, tensile strength (TS) is 590MPa(s). Fitness and elongation (El) made good 35% or more of thing for the above thing, and the following [it] were made into the defect, respectively. Moreover, the visual judgment of the plating nature was carried out, what a non-plated part is accepted in was made into the defect, and what a non-plated part is not accepted in was made good.

[0017] Hat time of heating process before hydrochloric-acid acid washing2 O/H2 in here In order to investigate why plating nature becomes it good that a division ratio is within the limits of said formula (1) by CGL, When the ferrite cross section of the steel plate surface after annealing is observed by SEM, as shown in drawing 4 , on the surface of the steel plate cooled on the cooling conditions of said formula (1) The about several micrometers precise internal oxidation layer is formed, and such precision was not looked at by the surface of the steel plate cooled on the conditions of said formula (1) out of range. It is thought that this internal oxidation layer makes the oxide of Fe, Si, and Mn a subject.

[0018] On the other hand, it is H2 O/H2. A division ratio shows oxygen potential. in order [namely,] to inhibit the diffusion to the surface of the dissolution Si and Mn which an internal oxidation layer generates at the time of a heating process since that the plating nature in CGL is improved has high oxygen potential, this internal oxidation layer remains just before plating, and exists in the interior of a ferrite from this internal oxidation layer at the time of CGL annealing -- as a result -- a front face -- concentration is controlled and it is presumed that plating nature has been improved.

[0019] Moreover, H2 O/H2 in annealing in the case of plating When a division ratio is within the limits of said formula (2), the reason the plating nature in CGL becomes good is considered as follows. That is, it is thought that the Fe-P system oxide which is comparatively hard to be returned to a steel plate front face is generating after acid washing, and in order to return this, it must heat on condition that below oxygen potential to some extent. if it is the oxygen potential which fills the relation of said formula (2), since this reduction reaction will advance enough -- as a result -- a front face -- concentration is controlled and it is presumed that plating nature has been improved.

[0020] Namely, in order that this invention person may get the high intensity melting galvanized steel sheet with which there were many contents of Si and Mn and the mechanical property excelled [nature / plating] in good on-the-strength ductility balance good By it not only securing a good mechanical property by specifying CAL and the cooling rate at the time of CGL annealing in the specific range, but specifying the ambient atmosphere at the time of the CAL dew-point determined with the amount of Si in steel, or cooling temperature, and CGL annealing Plating nature was also secured and it found out obtaining the high intensity melting galvanized steel sheet which was excellent in on-the-strength ductility balance as a result.

[0021] Furthermore, by this invention, in order to perform quenching quenching processing at the time of annealing, there is a big advantage that the galvanized steel sheet finally obtained can apply not only to hot rolled sheet steel but to cold rolled sheet steel, like JP,2-175817,A and the patent No. 1313144 official report. When annealing before plating is again given by CGL after that, the last organization

changes and it becomes impossible that is, to acquire a desired property by it, in order to perform quenching quenching processing at the time of hot-rolling, to perform cooling processing at the time of CAL annealing and to make the last organization from the conventional approach. However, it is because it is not necessary to ask the class of hot-rolling and cold-rolling of the steel plate before CAL plate leaping in order to perform quenching quenching processing at the time of annealing, to perform cooling processing again by this approach at the time of CGL annealing and to make the last organization.

[0022] The biggest difference between JP,2-175817,A of this invention, the patent No. 1313144 official report, JP,5-179356,A, JP,5-51647,A, etc. is making an internal oxidation layer required in order to improve plating nature form by CAL at the same time it performs quenching processing by CAL. That is, by said well-known approach, quenching processing is performed in a hot-rolling phase, and each is performing quenching processing by CAL. If this quenching processing is performed by CGL, it is possible to carry out plating processing to the steel plate currently carried out by said well-known approach, but since un-plating occurs when it was this approach and high Si and Mn steel are plated, reinforcement cannot be secured without degrading the ductility by Si addition, and a high intensity galvanized steel sheet with the outstanding mechanical property cannot be obtained.

[0023] Although the method of improving the plating nature of high Si and Mn steel by carrying out elevated-temperature rolling up like JP,10-17936,A also exists, since the steel in this invention has indispensable quenching processing, low-temperature rolling up is important for it. In low-temperature rolling up, since an internal oxidation layer cannot be formed, to the steel type of the high Si [in this invention], and Mn system, the approach of JP,10-17936,A is inapplicable.

[0024] On the other hand, in this invention, an internal oxidation layer required in order to improve plating nature is made to form by CAL, quenching processing seen by said well-known approach is performed by CGL, and it makes it indispensable to plate to coincidence at the same time it performs quenching processing by CAL. Therefore, since internal oxidation is carried out as mentioned above by about [that a steel plate can both choose hot-rolling and cold rolled sheet steel] and CAL, this invention can be adapted to the steel type of the high Si and Mn system, and can obtain the high intensity melting galvanized steel sheet which had the outstanding mechanical property as a result. Namely, the effectiveness of this invention will not be acquired without adding a CAL process between hot-rolling and CGL.

[0025] In addition, the approach of plating, after annealing in a high dew-point by aforementioned CAL is not necessarily limited only to a steel type with indispensable quenching processing. That is, although quenching processing is not needed, it cannot be overemphasized by plating, after being able to apply also to the steel type which cannot be plated with the usual approach and annealing in a high dew-point by CAL, since there are much Si, Mn, etc. that plating nature is greatly improvable.

[0026] Moreover, the rolling-up temperature (CT) of hot rolled sheet steel was higher than 600 degrees C, and when the cooling rates after rolling up are the following conditions by 3-degree-C/, the plating nature of high Si steel has been improved, but when these conditions are not fulfilled, plating nature has not been improved so that more clearly than drawing 5 . the dissociation oxygen supplied from the scale of hot rolled sheet steel highly [rolling-up temperature] when a cooling rate was slow -- the diffusion invasion from a ferrite front face -- carrying out -- an internal oxidation layer -- forming -- this -- the front face at the time of CGL annealing -- it is because it has the operation which controls concentration. Even if rolling-up temperature is high, if a cooling rate is too quick, forming [of an internal oxidation layer] will become inadequate and a plating nature improvement effect will not be acquired.

[0027] Desirable rolling-up temperature is 600 degrees C or more 850 degrees C or less. At less than 600 degrees C, since formation of an internal oxidation layer is inadequate, a plating nature improvement effect is hard to be acquired. If it exceeds 850 degrees C, a coil will carry out heat deformation. However, if a CAL dew-point is controlled enough, it is not necessary to necessarily raise the rolling-up temperature at the time of hot-rolling (CT). Moreover, a desirable cooling rate is the following by 3-degree-C/. If quicker than a part for 3-degree-C/, forming [of an internal oxidation layer] will become inadequate and a plating nature improvement effect will be hard to be acquired. The

more a cooling rate is slow, the more it is effective, but if a coil cooling rate is the following by 3-degree-C/mostly depending on a coil single pile, a plating nature improvement effect will be acquired almost satisfactory. It does not limit especially about a minimum.

[0028] Next, in this invention, the reason which limited a constituent, a content, and manufacture conditions is explained.

C: When 0.25wt% is exceeded, the hardenability after CGL annealing gets worse and it becomes impossible weldability not only to get worse, but to obtain desired complex tissue, although 0.05-0.25wt%C is an indispensable element and needs 0.05wt(s)% at least, in order to obtain required reinforcement, and in order to make the last organization into the complex tissue of tempering martensite and detailed martensite. Although desired complex tissue is obtained by quenching after CGL annealing in this invention, it is indispensable to have to make desired complex tissue form so that a postscript may be carried out, by the time it becomes 600 degrees C which is the upper limit of a cooling temperature control field, since plating bath invasion board temperature is 450-500 degrees C, and to secure good hardenability. Therefore, the upper limit of the amount of C in steel was made into 0.25wt (s)%, and the amount of C was limited to the range of 0.05 - 0.25wt%. The range of 0.08 - 0.15wt% is desirable.

[0029] Si: Less than [2.0wt%] Si promotes solid solution strengthening and good complex tissue-ization, and workability will be improved, if there is an operation improved advantageously and on-the-strength-elongation balance is used in not more than 2.0wt%. However, when it is used exceeding 2.0wt (s)%, it becomes difficult to improve plating nature. The range of 0.5 - 1.0wt% is desirable.

[0030] Mn: Like C, 1.0-2.5wt%Mn is an indispensable element, in order to obtain the complex tissue of required reinforcement and a request. In order to secure the good hardenability after CGL annealing and to prevent tempering it not only to to obtain predetermined reinforcement and complex tissue, but, 1.0wt (s)% is needed at least, but if 2.5wt% is exceeded, weldability will deteriorate. The range of 1.5 - 2.0wt% is desirable.

[0031] aluminum: Although 0.005-0.10wt%aluminum is a useful element which raises the cleanliness of steel by deacidification, if a content is not filled to 0.005wt(s)%, even if the addition effectiveness will be scarce and will add exceeding 0.10wt(s)% on the other hand, the effectiveness reaches saturation and causes degradation of an elongation property on the contrary. The range of 0.01 - 0.05wt% is desirable.

[0032] In this invention, although the content of C, Si, Mn, and aluminum is adjusted to said range, if the content is adjusted proper also about the element described below, the further improvement in a quality-of-the-material property may wish. The operation and suitable amount are described below.

[0033] Nb, Ti : All are precipitation-strengthening elements, and weldability can be raised, if Nb is 0.005 - 0.10wt% and the range of Ti is 0.01 - 0.20wt%. Effectiveness is saturated with the amount of under a minimum by any element, even if effectiveness is not acquired and it adds exceeding an upper limit.

[0034] Cr, nickel, Mo : Each of these elements is elements which raise hardenability, if they carries out optimum dose use, they can lead the operation which makes detailed increase of the martensite ratio in a CAL annealing and cooling time, and lath structure of martensite, can make good hardenability at the time of the reheating-cooling of two-phase region at the time of CGL annealing of degree process, can make final complex tissue after cooling good, and can raise various kinds of fabrication nature. In order to acquire this effectiveness, any element has the desirable addition beyond 0.10wt%, but since all are expensive elements, as for the viewpoint of a manufacturing cost to these upper limits, carrying out to <=(Cr+nickel+Mo) 1.0wt% is desirable.

[0035] P, S : Since all produce promotion of a segregation, the increment in nonmetallic inclusion, etc. and do a bad influence to various workability, decreasing as much as possible is desirable. However, in P, in less than [0.015wt%] and S, it is permissible if it is less than [0.010wt%] extent.

[0036] Cold-rolling process: In order to perform quenching quenching processing by CAL as described above, a steel plate does not ask the class of hot-rolling and cold-rolling. Therefore, in order to adjust board thickness according to an end use, you may cold-roll if needed. If the manufacture conditions after degree process are followed, since especially the effect by rolling in this phase will not be accepted,

especially rolling reduction is not limited.
[0037] CAL heating conditions: CAL annealing is requirements required when obtaining the complex tissue which there is no anisotropy as the last organization and has detailed and uniform tempering martensite and detailed martensite. That is, at less than 800 degrees C, the hardenability of the austenite grain immediately after finishing rolling gets worse [whenever / stoving temperature]. On the other hand, above 1000 degrees C, an austenite grain becomes big and rough too much, big and rough-ization of the lath structure of the martensite after cooling is caused, and a mechanical property deteriorates. Therefore, let whenever [stoving temperature] be the range of 800-1000 degrees C. The range of 890-950 degrees C is desirable. Moreover, quenching is inadequate in heating time being 10 or less seconds, in order to cause big and rough-ization of super-****** and martensite for 120 seconds, the range of heating time for 10 - 120 seconds is desirable, and especially the range for 40 - 80 seconds is desirable [heating time].
[0038] The ambient atmosphere at the time of CAL annealing: For the ambient atmosphere in a heating process, hydrogen concentration is H2 O in a 1 - 100wt% and heating ambient atmosphere, and H2. The ratio of each partial pressure receives the amount of Si in steel (wt%). 0.3 >=log(H2 O/H2) >=2Si(wt%)-4 (1)
It is desirable to satisfy a ** type. A formula (1) is H2 O/H2 shown in drawing 2 . It was drawn from the experimental result of the plating nature to the amount of Si in a division ratio and steel.
[0039] Having been referred to as log(H2 O/H2) >=2Si-4 is based on the following reasons. since [namely,] an internal oxidation layer is not enough formed at a heating process as log (H2 O/H2) is less than [2Si-4] -- the time of CGL annealing -- setting -- Si and Mn front face -- since concentration cannot be controlled, plating nature is not improved. On the other hand, it is H2 O/H2. Although -0.22 super-****** and Fe begin to oxidize in 0.6 (H2 O/H2), i.e., log, and a temper comes to be accepted depending on conditions, especially since some tempers are removed by subsequent acid washing, they are not problems.
[0040] However, securing hyperoxia potential hurts its furnace body a difficult top on a manufacture condition. Furthermore, it is H2 O/H2. If 2 (H2 O/H2), i.e., log, exceeds 0.30, since oxidation of about [become] and a ferrite surface becomes [a temper] is hard to be removed violently also in acid washing, poor formation of an internal oxidation layer will take place. Therefore, the upper limit of log (H2 O/H2) is to 0.3. Moreover, it is more desirable to contain hydrogen, even when it is small since it will especially become easy to generate the temper same at the time of high dew-point annealing, if hydrogen concentration is lower than 1wt%. Therefore, hydrogen concentration was made into the range of 1 - 100wt%. Desirable hydrogen concentration is 2 - 10wt%.
[0041] The cooling conditions at the time of continuous-annealing Rhine (CAL) annealing: In CAL, it quenches the heated steel plate to 300 degrees C or less. Especially the minimum of cooling temperature does not limit. At the cooling rate of less than 40 degrees C/second, or the cooling termination temperature exceeding 300 degrees C, sum total ratios, such as a proeutectoid ferrite under organization after cooling, a pearlite, and bainite, become high at 50% or more, and an anisotropy and homogeneity get worse. Although especially the upper limit of a cooling rate is not defined, it is enough in a second in 200 degrees C /. This is for effectiveness to reach saturation, even if it cools with the cooling rate beyond it. Therefore, the second of a cooling rate is indispensable in 40 degrees C /or more. Moreover, since quenching will stop being able to enter a little easily if there are many Si contents, it is desirable to make a cooling rate into speed. A desirable cooling rate is 50-150 degrees C/second, and it is desirable to quench to 250 degrees C or less.
[0042] acid-washing: -- the front face of easy-oxidizable elements, such as Si, Mn, etc. in which annealing and carrying out acid washing of the steel plate front face after cooling carries out surface concentration at the time of annealing, -- concentration -- it is for removing an object. the pickling weight loss of a steel plate -- Fe conversion -- 0.05 - 5 g/m2 carrying out acid washing -- a front face -- concentration -- an object is completely removable. Moreover, although the class of acid at this time, concentration, acid-washing time amount, especially acid-washing temperature, etc. are not asked, if acid-washing processing is carried out for 1 - 20 seconds, for example with a 40-90-degree C

hydrochloric acid [about / 1-10wt%], a sulfuric acid, and a nitric acid, a surface dark ghost is removable. the front face according to acid washing since pickling weight loss will become in transit at a target if concentration is thin -- concentration -- removal of an object is inadequate, and if 10wt% is exceeded, while pickling weight loss exceeds a target, since a dry area happens to the steel plate front face by fault acid washing and the cost price of an acid becomes high, it is not desirable.
[0043] the front face according that 40-90 degrees C is suitable for the temperature of an acid, and it is less than 40 degrees C to acid washing since pickling weight loss is in transit at a target -- concentration -- removal of an object is inadequate. If it exceeds 90 degrees C, while pickling weight loss exceeds a target, since the dry area on the front face of a steel plate by fault acid washing happens, it is not desirable. The range of 50-70 degrees C is desirable. the front face according that for 1 - 20 seconds is suitable for acid-washing time amount, and it is less than 1 second to acid washing -- concentration -- removal of an object is inadequate, and since the dry area on the front face of a steel plate by fault acid washing will happen, and production time will become long and it will lead to a cost rise if it exceeds 20 seconds, it is unsuitable. The range for 5 - 10 seconds is desirable.
[0044] Continuation melting galvanization line (CGL) heating conditions: If the steel plate adjusted as mentioned above is held to a 725-840-degree C temperature requirement with a continuation melting galvanization line, in the lath section of the part whose organization was martensite from the first, an austenite phase will be formed preferentially. It separates from this temperature requirement, or the tempering martensite and detailed martensite complex tissue which is asking by this invention that heating time is 5 or less seconds are not formed. Therefore, as for heating in a continuation melting galvanization line, it is desirable to hold for 5 - 200 seconds in a 725-840-degree C temperature requirement. Even if it exceeds 200 seconds, effectiveness is saturated and a consecutive-processing process is not turned to. It is desirable to hold for 10 - 40 seconds in a 730-800-degree C temperature requirement.
[0045] The cooling conditions at the time of CGL annealing: Although the austenite grain with C concentration low again usually is unstable and hardenability is low, since the austenite grain at the time of the two-phase region heating in this invention is detailed, it is very stable, and does not need to gather a cooling rate so much. Therefore, the cooling rate at the time of annealing is carried out in 2-50 degrees C/second. Compound systematizing becomes inadequate [in a second] in less than 2 degrees C /, and a good mechanical property is no longer acquired. Effectiveness is saturated even if it exceeds a second in 50 degrees C /.
[0046] It is because it becomes inadequate forming [of martensite] to have made the upper limit of cooling control temperature into 600 degrees C after finishing cooling control exceeding this temperature, and it becomes impossible to acquire the target property. It does not ask especially about a minimum. Moreover, since quenching will stop being able to enter a little easily if there are many Si contents, to speed up a cooling rate is desired. Since hardenability will deteriorate if it separates also from one of C specified by this invention, and the amounts of Mn from said range, it becomes impossible to obtain desired complex tissue at 600 degrees C, but if it is the range of this invention, it is possible to obtain desired complex tissue.
[0047] The ambient atmosphere of CGL annealing: In order to return the oxide film generated on the steel plate front face and to secure plating nature after acid washing, to be sufficient reducing atmosphere is desired. It is necessary to specifically return completely not only Fe system oxide but P system oxide which is harder to be returned. H2 O/H2 which P system oxide of this invention returns Drawing thermodynamically the formula (2) which calculates a value using the formula of the oxide free energy of formation, f (T) packs the thermodynamic parameter about P system oxide and H2 O into one formula. Therefore, the range of oxygen potential required for the plating nature reservation in the temperature of arbitration, i.e., a dew-point, and hydrogen concentration is calculable from this formula (2).
[0048] That is, this invention persons find out and stabilized things that the annealing ambient atmosphere of plating nature reservation should just be the condition range which can return P system oxide. It becomes impossible to return an oxide film here as oxygen potential of this invention is out of

range, plating nature cannot be secured, and it is not desirable. If it is the hydrogen concentration which fills this condition range, and the combination of a dew-point, plating nature reservation is possible on any conditions. However, if hydrogen concentration is lower than 1wt%, since it is hard to return an oxide film, it is not desirable. Therefore, hydrogen concentration was made into the range of 1 - 100wt%. The range of 3 - 20wt% is desirable.

[0049] After annealing as mentioned above, it galvanizes with a conventional method in the usual melting galvanization bath. a galvanization bath -- aluminum -- 0.08 - 0.2wt% -- what is contained is suitable and 450-500 degrees C is suitable for bath temperature. Moreover, 450-500 degrees C is suitable for the board temperature when invading during a bath.

[0050] Moreover, the obtained galvanized steel sheet can perform melting alloying processing if needed. It is desirable the range of about 450-550 degrees C and to perform especially alloying in 480-520 degrees C. Alloying hardly advances that it is less than 450 degrees C. It is not desirable in order to cause degradation of the adhesion of the deposit by too much alloying, if it exceeds 550 degrees C. Moreover, Fe diffusing capacity in the deposit after alloying needs to fit in the range of 8 - 11wt%. If it is less than [8wt%], the sliding nature which it can burn and nonuniformity etc. not only occurs, but depends insufficiently [alloying] will deteriorate, and if 11wt(s)% is exceeded, plating adhesion will deteriorate with a fault alloy. The range of 9 - 10wt% is desirable. The approach of melting alloying is not limited especially that what is necessary is just a gas heating furnace, an induction heating furnace, etc.

[0051]

[Example] Continuous casting slab with a thickness [of the chemical composition (C, Si, Mn, P, S, aluminum, in addition to this) shown in the [Example 1-43] tables 1-4] of 300mm was heated at 1200 degrees C, and it considered as hot rolled sheet steel with a thickness of 2.3mm with the finishing mill of seven stands after rough rolling of three pass, and rolled round at 500-750 degrees C. After acid washing, when cold-rolling was carried out, rolling reduction was made into 50%, plate leaping was carried out to CAL, and it heated on the conditions (division ratio of temperature, the holding time, hydrogen concentration, a steam, and hydrogen) shown in Tables 1-4, and quenched and annealed on the conditions (a rate, termination temperature) shown in Tables 1-4. Subsequently, plate leaping was carried out to CGL and acid washing was carried out for 10 - 20 seconds with 60-degree C 5% hydrochloric acid or 5% sulfuric acid. Pickling weight loss was shown in Tables 1-4. The effectiveness, that any acid was equivalent was acquired.

[0052] Subsequently, it heated on the conditions (division ratio of temperature, the holding time, hydrogen concentration, a steam, and hydrogen) shown in Tables 5-8, and quenched and annealed on the conditions (a rate, termination temperature) shown in Tables 5-8. Then, it galvanized at the temperature of 490 degrees C, and melting alloying processing was further performed for 20 seconds at the temperature of 470 degrees C. the coating weight of plating -- double-sided 40 g/m2 it was .

[0053]

[Table 1]

表 1 (条 件)

例	化学組成 (wt%)							冷却の有無	CAL焼鈍条件							酸洗減量 (g/m²)
	C	Si	Mn	P	S	Al	他		温度 (℃)	保持時間 (sec)	冷却速度 (℃/sec)	強制冷却終了速度 (℃)	露点 (℃)	H_2 (%)	$\log(H_2O/H_2)$	
1	0.15	0.5	1.5	0.010	0.003	0.03		無	900	80	40	200	-35	3	-2.13	0.5
2	0.15	0.7	1.5	0.010	0.003	0.03		無	900	80	40	200	-25	3	-1.68	0.5
3	0.15	0.7	1.5	0.010	0.003	0.03		有	900	80	40	200	-25	3	-1.68	0.1
4	0.15	1.0	1.5	0.010	0.003	0.03		無	900	80	50	200	-10	3	-1.07	3
5	0.15	1.0	1.5	0.010	0.003	0.03		無	900	80	50	200	-10	3	-1.07	0.5
6	0.15	1.0	1.5	0.010	0.003	0.03		有	900	80	50	200	-10	3	-1.07	0.5
7	0.15	1.0	1.5	0.010	0.003	0.03		無	900	40	50	200	-10	3	-1.07	0.5
8	0.15	1.0	1.5	0.010	0.003	0.03		無	900	100	50	200	-10	3	-1.07	0.5
9	0.15	1.0	1.5	0.010	0.003	0.03		無	900	80	60	200	-10	3	-1.07	0.5
10	0.15	1.0	1.5	0.010	0.003	0.03		無	900	80	100	200	-10	3	-1.07	0.5
11	0.15	1.0	1.5	0.010	0.003	0.03		無	900	80	40	100	-10	3	-1.07	0.5
12	0.15	1.0	1.5	0.010	0.003	0.03		無	900	80	40	200	-20	3	-0.12	0.5
13	0.15	1.0	1.5	0.010	0.003	0.03		無	900	80	40	200	-10	3	-1.07	0.5

[0054]
[Table 2]

表 2 (条 件)

例	化学組成 (wt%)							冷却の有無	CAL焼鈍条件							酸洗減量 (g/m²)
	C	Si	Mn	P	S	Al	他		温度 (℃)	保持時間 (sec)	冷却速度 (℃/sec)	強制冷却終了速度 (℃)	露点 (℃)	H_2 (%)	$\log(H_2O/H_2)$	
14	0.15	1.0	1.5	0.010	0.003	0.03		無	900	80	40	200	-10	3	-1.07	0.5
15	0.15	1.0	1.5	0.010	0.003	0.03		無	900	80	40	200	-10	3	-1.07	0.5
16	0.15	1.0	1.5	0.010	0.003	0.03		無	900	80	40	200	-10	3	-1.07	0.5
17	0.15	1.0	1.5	0.010	0.003	0.03		無	900	80	40	200	-10	3	-1.07	0.5
18	0.15	1.5	1.5	0.010	0.003	0.03		無	900	80	40	200	+10	3	-0.39	0.5
19	0.15	2.0	1.5	0.010	0.003	0.03		無	900	80	40	200	+25	3	0.01	0.5
20	0.17	1.0	1.7	0.011	0.004	0.04	0.1C	無	900	80	40	200	-10	3	-1.07	0.5
21	0.14	1.0	1.7	0.010	0.003	0.03	0.1Mo	無	900	80	40	200	-10	3	-1.07	0.5
22	0.16	1.0	1.4	0.009	0.004	0.03	0.01Nb	無	900	80	40	200	-10	3	-1.07	0.5
23	0.13	1.0	1.5	0.001	0.003	0.05	0.01Nb -0.02Ti	無	900	80	40	200	-10	3	-1.07	0.5
24	0.14	1.0	1.6	0.010	0.003	0.03		無	700	80	40	200	-10	3	-1.07	0.5
25	0.14	1.0	1.6	0.010	0.003	0.03		無	1100	80	40	200	-10	3	-1.07	0.5

[0055]
[Table 3]

表 3 (条件)

例	化学組成(wt%)							冷却の有無	CAL焼鈍条件							酸洗減量 (g/m²)
	C	Si	Mn	P	S	Al	他		温度 (℃)	保持時間 (sec)	冷却速度 (℃/sec)	強制冷却終了速度 (℃)	露点 (℃)	H_2 (%)	$\log(H_2O/H_2)$	
26	0.15	1.0	1.5	0.009	0.003	0.05		無	900	2	40	200	-10	3	-1.07	0.5
27	0.15	1.0	1.5	0.009	0.003	0.03		無	900	200	40	200	-10	3	-1.07	0.5
28	0.15	1.0	1.5	0.010	0.003	0.03		無	900	80	10	200	-10	3	-1.07	0.5
29	0.15	1.0	1.4	0.010	0.003	0.03		無	900	80	40	600	-10	3	-1.07	0.5
30	0.15	1.0	1.5	0.010	0.009	0.03		無	900	80	40	200	-35	3	-2.13	0.5
31	0.16	0.7	1.6	0.010	0.003	0.03		無	900	80	40	200	-45	3	-2.62	0.5
32	0.12	1.5	1.7	0.010	0.003	0.03		無	900	80	40	200	-10	3	-1.07	0.5
33	0.12	2.0	1.6	0.010	0.003	0.03		無	900	80	40	200	0	3	-0.7	0.5
34	0.17	1.1	1.5	0.010	0.004	0.03		無	900	80	40	200	-45	0.5	-1.84	0.5
35	0.17	1.1	1.5	0.010	0.004	0.03		無	900	80	40	200	-20	3	-1.47	0.5
36	0.17	1.0	1.5	0.010	0.004	0.03	0.01Nb	無	900	80	40	200	-20	3	-1.47	0.5

[0056]
[Table 4]

表 4 (条件)

例	化学組成(wt%)							冷却の有無	CAL焼鈍条件							酸洗減量 (g/m²)
	C	Si	Mn	P	S	Al	他		温度 (℃)	保持時間 (sec)	冷却速度 (℃/sec)	強制冷却終了速度 (℃)	露点 (℃)	H_2 (%)	$\log(H_2O/H_2)$	
37	0.14	1.0	1.6	0.010	0.003	0.03		無	900	80	40	200	-10	3	-1.07	0.5
38	0.14	1.0	1.6	0.010	0.003	0.03		無	900	80	40	200	-10	3	-1.07	0.5
39	0.15	1.0	1.5	0.009	0.003	0.03		無	900	80	10	200	-10	3	-1.07	0.5
40	0.15	1.0	1.5	0.009	0.003	0.03		無	900	80	40	600	-10	3	-1.07	0.5
41	0.15	1.0	1.5	0.010	0.003	0.03		無	900	80	40	200	-10	3	-1.07	0.5
42	0.15	1.0	1.4	0.010	0.003	0.03		無	900	80	40	200	-10	3	-1.07	6
43	0.15	1.0	1.5	0.010	0.003	0.03		無	900	80	40	200	-10	3	-1.07	0.01

例37～43は比較例。

[0057]
[Table 5]

表 5 (条件)

例	2Si-4	連続溶融亜鉛メッキ条件								合理化処理
		温度 (℃)	保持時間 (sec)	冷却速度 (℃/sec)	強制冷却終了速度 (℃)	露点 (℃)	H_2 (%)	H_2O/H_2	exp(f(T)/RT)	
1	-3.00	750	20	5	500	-35	5	0.0045	0.53	有
2	-2.60	750	20	10	500	-35	5	0.0045	0.53	有
3	-2.60	750	20	10	500	-35	5	0.0045	0.53	有
4	-2.00	750	20	20	500	-35	5	0.0045	0.53	有
5	-2.00	750	20	20	500	-35	5	0.0045	0.53	無
6	-2.00	750	20	20	500	-35	5	0.0045	0.53	有
7	-2.00	750	20	20	500	-35	5	0.0045	0.53	有
8	-2.00	750	20	20	500	-35	5	0.0045	0.53	有
9	-2.00	750	20	20	500	-35	5	0.0045	0.53	有
10	-2.00	750	20	20	500	-35	5	0.0045	0.53	有
11	-2.00	750	20	20	500	-35	5	0.0045	0.53	有
12	-2.00	750	20	20	500	-35	5	0.0045	0.53	有
13	-2.00	780	20	20	500	-35	5	0.0045	0.54	有

[0058]
[Table 6]

表 6 (条件)

例	2Si-4	連続溶融亜鉛メッキ条件								合理化処理
		温度 (℃)	保持時間 (sec)	冷却速度 (℃/sec)	強制冷却終了速度 (℃)	露点 (℃)	H_2 (%)	H_2O/H_2	exp(f(T)/RT)	
14	-2.00	750	60	20	500	-35	5	0.0045	0.53	有
15	-2.00	750	20	50	500	-35	5	0.0045	0.53	有
16	-2.00	750	20	20	490	-35	5	0.0045	0.53	有
17	-2.00	750	20	20	500	-40	5	0.0026	0.53	有
18	-1.00	750	20	25	500	-35	5	0.0045	0.53	有
19	0.00	750	20	30	500	-35	5	0.0045	0.53	有
20	-2.00	750	20	20	500	-35	5	0.0045	0.53	有
21	-2.00	750	20	20	500	-35	5	0.0045	0.53	有
22	-2.00	750	20	20	500	-35	5	0.0045	0.53	有
23	-2.00	750	20	20	500	-35	5	0.0045	0.53	有
24	-2.00	750	20	20	500	-35	5	0.0045	0.53	有
25	-2.00	750	20	20	500	-35	5	0.0045	0.53	有

[0059]
[Table 7]

表 7 (条 件)

例	2Si-4	連続溶融亜鉛メッキ条件								合理化処理
		温度 (℃)	保持時間 (sec)	冷却速度 (℃/sec)	強制冷却終了速度 (℃)	露点 (℃)	H_2 (%)	H_2O/H_2	exp(f(T)/RT)	
26	-2.00	750	20	20	500	-35	5	0.0045	0.53	有
27	-2.00	750	20	20	500	-35	5	0.0045	0.53	有
28	-2.00	750	20	20	500	-35	5	0.0045	0.53	有
29	-2.00	750	20	20	500	-40	5	0.0026	0.53	有
30	-2.00	750	20	20	500	-35	5	0.0045	0.53	有
31	-2.60	750	20	20	500	-35	5	0.0045	0.53	有
32	-1.00	750	20	20	500	-35	5	0.0045	0.53	有
33	0	750	20	20	500	-35	5	0.0045	0.53	有
34	-1.80	750	20	20	500	-35	5	0.0045	0.53	有
35	-1.80	750	20	20	500	20	4	0.5725	0.53	有
36	-1.80	750	20	20	500	-10	0.5	0.5132	0.53	有

[0060]
[Table 8]

表 8 (条 件)

例	2Si-4	連続溶融亜鉛メッキ条件								合理化処理
		温度 (℃)	保持時間 (sec)	冷却速度 (℃/sec)	強制冷却終了速度 (℃)	露点 (℃)	H_2 (%)	H_2O/H_2	exp(f(T)/RT)	
37	-2.00	900	20	20	500	-35	5	0.0045	0.59	有
38	-2.00	650	20	20	500	-35	5	0.0045	0.48	有
39	-2.00	750	1	20	500	-35	5	0.0045	0.53	有
40	-2.00	750	20	1	500	-35	5	0.0045	0.53	有
41	-2.00	750	20	20	700	-35	5	0.0045	0.53	有
42	-2.00	750	20	20	500	-35	5	0.0045	0.53	有
43	-2.00	750	20	20	500	-35	5	0.0045	0.53	有

例37～43は比較例。

[0061] The result investigated about the mechanical property of said steel plate, and plating nature and plating adhesion was shown in Tables 9-10. The mechanical property made good tensile strength TS>=590MPa and the thing which is elongation El>=35%, and made the other thing the defect. Plating nature evaluated the appearance after plating by viewing, and made x that in which ** and un-plating generated that in which the ripple generated the thing without a non-plated part although there were not O and a non-plated part. plating adhesion -- the deposit after 90-degree bending return and by the side of compression -- a Scotch tape friction test -- carrying out -- unit length -- (-- Zn number of counts by the fluorescence X rays of per m) was measured, and it evaluated in the light of the criteria of Table 11. What has the few number of counts is good. The appearance after alloying made O that from which there are not x and alloying nonuniformity about what alloying nonuniformity was accepted in, and the appearance of homogeneity was acquired, and carried out visual evaluation.

[0062]
[Table 9]

表 9（結 果）

例	引張強度 TS	伸 び EI	メッキ性	メッキ密着性	合金化後の外観
1	良 好	良 好	○	1	○
2	良 好	良 好	○	1	○
3	良 好	良 好	○	2	○
4	良 好	良 好	○	1	○
5	良 好	良 好	○	2	－（合金化せず）
6	良 好	良 好	○	2	○
7	良 好	良 好	○	2	○
8	良 好	良 好	○	2	○
9	良 好	良 好	○	2	○
10	良 好	良 好	○	1	○
11	良 好	良 好	○	1	○
12	良 好	良 好	○	1	○
13	良 好	良 好	○	2	○
14	良 好	良 好	○	2	○
15	良 好	良 好	○	1	○
16	良 好	良 好	○	1	○
17	良 好	良 好	○	1	○
18	良 好	良 好	○	3	○
19	良 好	良 好	○	3	○
20	良 好	良 好	○	2	○
21	良 好	良 好	○	1	○
22	良 好	良 好	○	1	○

[0063]
[Table 10]

表 10（結 果）

例	引張強度 TS	伸び El	メッキ性	メッキ密着性	合金化後の外観
23	良 好	良 好	○	2	○
24	不 良	不 良	○	2	○
25	不 良	不 良	○	2	○
26	不 良	不 良	○	2	○
27	不 良	不 良	○	2	○
28	不 良	不 良	○	1	○
29	不 良	不 良	○	2	○
30	良 好	良 好	△	3	○
31	良 好	良 好	△	3	○
32	良 好	良 好	△	3	○
33	良 好	良 好	△	3	○
34	良 好	良 好	△	3	○
35	良 好	良 好	△	3	○
36	良 好	良 好	△	3	○
37	不 良	不 良	○	1	○
38	不 良	不 良	○	1	○
39	不 良	不 良	○	2	○
40	不 良	不 良	○	1	○
41	不 良	不 良	○	2	○
42	良 好	良 好	×	5	×
43	良 好	良 好	×	5	×

例37～43は比較例。

[0064]
[Table 11]

表 11

蛍光X線によるカウント数	ラ ン ク
0～500	1（良）
500～1000	2
1000～2000	3
2000～3000	4
3000以上	5（劣）

[0065] The defect in which it did not plate did not occur, but to being satisfactory in any way also about plating nature, plating adhesion, the appearance after alloying, and a mechanical property, since CAL annealing conditions and CGL annealing conditions differed from hot-rolling conditions in the example of a comparison, the defect in which it did not plate occurred, and each melting galvanized steel sheet manufactured by the manufacture approach of this invention had plating quality or a poor mechanical characteristic.

[0066] The continuous casting slab used in Examples 1-4 of the [Example 44-51] table 1 was heated at

1200 degrees C, and after rough rolling of three pass, it rolled out on the conditions (rolling-up temperature (CT), cooling rate after rolling up) shown in Table 12, considered as hot rolled sheet steel with a thickness of 2.3mm with the finishing mill of seven stands, and rolled round at 500-750 degrees C. After acid washing, when cold-rolling was carried out, rolling reduction was made into 50%, plate leaping was carried out to CAL, and it heated on the conditions (temperature, hydrogen concentration) shown in Table 12, and quenched and annealed on the conditions (the rate after CAL annealing, cooling termination temperature) shown in Table 12.

[0067] Subsequently, plate leaping was carried out to CGL and acid washing was carried out for 10 - 20 seconds with 60-degree C 5% hydrochloric acid or 5% sulfuric acid. Pickling weight loss was shown in Table 12. The effectiveness that any acid was equivalent was acquired. Subsequently, it heated on the conditions (CGL annealing temperature, holding time, hydrogen concentration) shown in Table 12, and quenched and annealed on the conditions (termination temperature after annealing) shown in Table 12. Then, it galvanized at the temperature of 470 degrees C, and melting alloying processing was further performed for 20 seconds at the temperature of 490 degrees C. the coating weight of plating -- double-sided 40 g/m2 it was .

[0068] The result investigated about the mechanical property of the obtained galvanized steel sheet, and plating nature and plating adhesion was shown in Table 13. The defect in which it did not plate did not occur, but to being satisfactory in any way also about plating nature, plating adhesion, the appearance after alloying, and a mechanical property, since CAL annealing conditions and CGL annealing conditions differed from hot-rolling conditions in the example of a comparison, the defect in which it did not plate occurred, and each melting galvanized steel sheet manufactured by the manufacture approach of this invention had plating quality or a poor mechanical characteristic.

[0069]

[Table 12]

表 12 (条 件)

例	鋼	熱延条件		冷延	CAL焼鈍条件					酸洗減量	連続溶融亜鉛メッキ条件					合金化処理
		CT	冷却速度 (℃/sec)		温度 (℃)	冷却速度 (℃/sec)	冷却終了温度 (℃)	露点 (℃)	H_2 (%)	(g/m²)	温度 (℃)	保持時間 (sec)	冷却終了温度 (℃)	露点 (℃)	H_2 (%)	
44	1	670	1	有	900	40	200	-45	3	0.5	750	20	500	-35	5	有
45	2	700	2	有	900	40	200	-45	3	0.5	750	20	500	-35	5	有
46	2	680	3	無	900	10	200	-45	3	0.5	750	20	500	-35	5	有
47	2	680	2	有	900	40	600	-45	3	0.5	750	20	500	-35	5	無
48	3	680	3	有	900	40	200	-45	3	0.5	750	20	500	-35	5	有
49	4	680	2	有	900	40	200	-45	3	0.5	750	20	500	-35	5	有
50	2	580	2	有	900	40	200	-45	3	0.5	750	20	500	-35	5	有
51	2	630	4	有	900	40	200	-45	3	0.5	750	20	500	-35	5	有

例50～51は比較例。

(注) 鋼欄の数字1～4は、表1の例1～4の鋼の番号に対応する番号である。

[0070]

[Table 13]

表 13（結 果）

例	引張強度 TS	伸び El	メッキ性	メッキ密着性	合金化後の外観
44	良 好	良 好	○	1	○
45	良 好	良 好	○	1	○
46	良 好	良 好	○	1	○
47	良 好	良 好	○	1	－（合金化せず）
48	良 好	良 好	○	1	○
49	良 好	良 好	○	1	○
50	良 好	良 好	×	4	×
51	良 好	良 好	×	4	×

例50～51は比較例。

[0071]
[Effect of the Invention] According to the approach of this invention, the defect in which it does not plate does not occur, but plating nature, plating adhesion, the appearance after alloying, and a mechanical property are good, and manufacture of the high intensity melting galvanized steel sheet excellent in on-the-strength ductility balance is possible, and when this steel plate is used for road transport department material, lightweight-izing of an automobile and low-fuel-consumption-ization can be enabled, as a result it can contribute to the improvement of earth environment greatly.

[Translation done.]